A Department of Ecology
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WASHINGTON STATE DEPARTMENT OF ECOLOGY

Establishment of an Annual Average Daily Traffic Threshold for Applying Enhanced Treatment (Dissolved Metals Removal)

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Introduction

The Department of Ecology received a number of comments in regard to the proposal in the draft update of the western Washington stormwater manual to set an Annual Average Daily Traffic (AADT) level for the application of Enhanced Treatment to roads. A significant portion of the comments were recommendations concerning how/whether to set an AADT threshold given the limits of the reported Caltrans data. The Caltrans data used in the proposal were reported using artificial groupings into urban highways (greater than 30,000 AADT), and non-urban highways (less than 30,000 AADT). The urban highway data included frequent exceedances of acute water quality standards for copper and zinc. The non-urban data set included fewer exceedances that were also generally not as high as the urban data set. The Ecology proposal speculated that by setting the threshold for use of Enhanced Treatment at 15,000 AADT, it would reduce the frequency of exceedances substantially.

Since then, Ecology has been able to review the '02 – '03 Caltrans data in more detail. It was possible to identify specific composite event mean concentrations for each storm at each site, and to list the AADT for each site. Tables 1 and 2 below rank-order the sites by AADT through 65,000 AADT.

Composite sample concentrations collected by Caltrans at these sites were compared with the acute water quality criteria for dissolved zinc and copper at 25 mg/l and 50 mg/l hardness. Hardness is frequently within this range in western Washington. However, values below 25 mg/l are common.

Ecology also tabulated frequencies with which the composite concentrations exceed the acute criteria by factors of 2x, 3x, and 5x. This was done for a hardness of 25 mg/l. This comparison is done to get a feel for the amount of dilution that would be necessary in order to not cause a violation of surface water quality standards.

Also included is a summary of congested versus free-flowing data reported by Caltrans, and data from a 1998 report published by the Michigan Dept. of Transportation.

NOTE: *Dissolved metals concentrations were directly measured in the Caltrans study. Where dissolved metals are not directly measured, the literature indicates that dissolved copper concentrations are usually 45% - 50% of total Copper. Dissolved zinc is usually 30% – 40% of total zinc.*

Summary of Caltrans Data from '02 – '03 Report

Table 1:
Dissolved Copper

Site (County)	AADT	# of values exceeding acute std For hardness of:		>2x std	>3x	> 5x
		25 mg/l	50 mg/l	for 25 mg/l hardness		
San Benito	1575	0/6	0/6	0	0	0
Mendocino	1800	4/7	2/7	2/7	1/7	0
Mariposa	2100	2/8	0/8	0	0	0
Tehama	2150	1/8	0/8	0	0	0
Humboldt	2700	3/8	1/8	0	0	0
Tuolomne	4075	0/8	0/8	0	0	0
Inyo	5800	0/2	0/2	0	0	0
Mendocino	5800	2/8	1/8	1/8	1/8	1/8
Humboldt	9550	4/8	2/8	1/8	0	0
San Luis Obispo	13,250	5/5	1/5	2/5	1/5	0
Kings	14,450	6/6	5/6	4/6	2/6	0
San Luis Obispo	23,000	2/2	2/2	2/2	0	0
Tehama	29,000	8/8	5/8	5/8	0	0
Placer	36,000	8/8	5/8	5/8	2/8	0
San Joaquin	41,350	7/8	7/8	7/8	5/8	3/8
Tulare	46,000	7/7	7/7	7/7	7/7	6/7
Solano	53,000	7/8	4/8	4/8	2/8	1/8
Santa Cruz	55,000	6/6	5/6	5/6	4/6	0/6
Riverside	65,000	5/5	4/5	4/5	1/5	0/5

Table 2:
Dissolved Zinc

Site	AADT	# of values exceeding acute std For hardness of: 25 mg/l	50 mg/l	>2x std for 25 mg/l hardness	>3x	>5x
San Benito	1575	0/6	0/6	0	0	0
Mendocino	1800	2/7	1/7	1/7	1/7	1/7
Mariposa	2100	1/8	0/8	0	0	0
Tehama	2150	1/12	0/12	0	0	0
Humboldt	2700	0/8	0/8	0	0	0
Tuolomne	4075	0/8	0/8	0	0	0
Inyo	5800	0/2	0/2	0	0	0
Mendocino	5800	3/8	1/8	1/8	1/8	1/8
Humboldt	9550	0/8	0/8	0	0	0
San Luis Obispo	13,250	3/5	0/5	0/5	0/5	0
Kings	14,450	6/6	1/6	1/6	0/6	0
San Luis Obispo	23,000	2/2	0/2	0	0	0
Tehama	29,000	2/4	0/4	0	0	0
Placer	36,000	3/8	0/8	0	0	0
San Joaquin	41,350	7/8	5/8	4/8	3/8	2/8
Tulare	46,000	7/7	7/7	7/7	3/7	2/7
Solano	53,000	4/8	1/8	1/8	0	0
Santa Cruz	55,000	5/6	2/6	2/8	1/8	0
Riverside	65,000	3/5	1/5	0	0	0

Congested versus Free flowing: Caltrans

(from Table 3 of the " '01 – '02 Annual Data Summary Report")
(values in micrograms per liter)

	free-flowing		congested	
	mean	std dev.	mean	std dev.
dissolved Zn:	116	53	171	90
dissolved Cu:	32.3	12.22	38.2	13.3

(from Table 3 of the " '02 – '03 Annual Data Summary Report")
(values in micrograms per liter)

	free-flowing		congested	
	mean	std dev.	mean	std dev.
dissolved Zn:	27.3	12.2	74.1	63.3
dissolved Cu:	12.9	7.1	19.1	11.3

"Highway Stormwater Runoff Study," Michigan Dept. of Transportation

CH2M Hill – April 1998

Site – AADT	Zinc (µg/l)	Copper (µg/l)
Marne – 25,000	78.5, 43.9, 63.9, 110	13.9, 4.8, 8.9
Grand Rapids – 18,000	11.5, 11.6, 6.4	8.6, 1.96
Ann Arbor – 56,000	10.9	9.0, 5.5, 5.3

Annual Ave. Precip. 36 inches

Dissolved/Total Cu: 63%
" " Zn: 53%

Authors speculate that the Grand Rapids and Ann Arbor sites were substantially lower because samples were collected after the runoff passed through a grassed swale. The Marne site samples were taken at the roadside.

Dissolved Zinc

Site	AADT	# of values exceeding acute std		>2x std	>3x std
		For hardness of:			
		25 mg/l	50 mg/l		
Marne	25,000	4/4	3/4	2/4	1/4
Grand Rapids	18,000	0/3	0/3	0	0
Ann Arbor	56,000	0/1	0/1		

Dissolved Copper

Site	AADT	# of values exceeding acute std		>2x std	>3x std
		For hardness of:			
		25 mg/l	50 mg/l		
Marne	25,000	3/3	2/3	1/3	1/3
Grand Rapids	18,000	1/2	0/2	0	0
Ann Arbor	56,000	3/3	1/3	0	0

Observations on the Caltrans Data:

Although a linear correlation with AADT is not made, even at these lower AADT levels you can see gradual increases in concentrations and in the frequencies with which the acute criteria are exceeded.

The Caltrans '02 – '03 Statewide Discharge Characterization Report includes the following conclusions:

- "AADT is the most important site characteristic in predicting highway runoff quality."
- "Pollutant build-up and wash-off are evident in the statistical analysis of the highway runoff quality data, providing support for the concepts of seasonal and event first flush effects."

At a hardness of 25 mg/l, almost every sample (61/63) exceeded the acute criteria for copper for sites at or above 13,250 AADT.

The California data mostly spans November through April. A quick review of the time between storm events at those times of year indicates that for many sites, the time between storms is not too dissimilar than the time between events during our most critical time of the year – August/September/early October. Time between rain events was one of the factors identified as significantly influencing runoff concentrations.

The extent by which the acute criteria are exceeded is significantly less than an order of magnitude. So, where enough dilution water with lower metals concentration occurs, there should not be a water quality standards compliance problem after application of basic treatment. Conversely, where we don't have lots of dilution water, and where the background water includes a large urban stormwater component, there is a significant chance that there could be a metals concentration problem.

There is a significant difference in the concentrations from congested highways versus free-flowing highways. Consequently, there is a justification for a lower AADT threshold for roads that involve braking – whether it's braking for traffic lights or braking due to traffic congestion.

Restatement of Presumptive Approach of Stormwater Manuals

The comments that were received on the draft proposal indicate that Ecology should re-state the intended use of the manual.

Ecology has described the manual as a generic, default approach to determining appropriate methods of treatment, flow control, and pollution prevention. It is a one- size-fits-all approach. Because of that, there will be situations where it is more than what is necessary (though in regard to treatment, state and federal law require use of reasonable pollution control regardless of the quality of the receiving water); and situations where it is not adequate to prevent significant adverse impacts. Ecology contends that the default approaches in the manual should result in substantial compliance with water quality standards and federal and state water quality laws in most situations. Ecology does not guarantee that these approaches protect all resources, all the time, in all areas. An approach that would accomplish the latter would require a more conservative, generic approach: higher treatment levels, greater flow control requirements, more aggressive pollution prevention measures, and restrictions on the extent that land is disturbed within a drainage basin.

The use of a generic approach is a policy choice borne out of risk management, and limited budgets. Regulatory agencies cannot possibly review the specific details of every new development and re-development project in regard to potential water quality impacts. Requiring every project proponent to use the traditional site-specific engineering analysis required of wastewater discharges to determine treatment and flow control would be an overwhelming significant cost and time burden. Therefore a generic, default approach is used for stormwater management. The choice of the default, generic approaches to apply is also a policy choice. It is the Dept. of Ecology's opinion, that a default, generic approach should not be one that protects all resources, all

the time, in all areas. From the standpoints of regulatory fairness and efficiency, it makes more sense to adopt an approach that should work in most cases, and then use the case-by-case discretionary review allowed by federal and state laws to address those situations in which the default approach is most likely insufficient, or where the risk to the resource is too great to use the defaults.

Ecology reserves the right, and other natural resource agencies should also reserve the right, to determine pollution control requirements on a case-by-case basis wherever they surmise that the generic approach may not achieve the desired protection.

Revised Proposal

In light of the additional data analysis and the philosophy of the Dept. of Ecology in regard to the establishment of a generic, default regulatory approach, the AADT proposal has been changed from that described in the draft proposal. The 2005 update of the "Stormwater Management Manual for Western Washington" will include the statements directly below.

Enhanced treatment applies to highways and roads as follows:

Within urban growth management areas:

- *Fully controlled and partially controlled limited access highways with a 20-year projected annual average daily traffic (AADT) of 15,000 or greater.*
- *All other roads with a 20-year projected AADT of 7,500 or greater;*

Outside of urban growth management areas:

- *Roads with an AADT of 15,000 or greater unless discharging to a 4th Strahler order stream or larger.*
- *Roads with an AADT of 30,000 or greater if discharging to a 4th Strahler order stream or larger (using 1:24,000 scale maps to delineate stream order);*

Note: Discharges to "Basic Treatment Receiving Waters" may apply Basic Treatment regardless of AADT.

The primary differences with the previous draft are as follows:

The 7,500 AADT applies to all roads, including state highways that are not limited access highways. Within urban areas, state highways that are not limited access function as urban arterials, so they should be treated the same.

A higher threshold (30,000 AADT) is applied to roads outside of the urban area that discharge to larger streams. The data indicate that below roughly 30,000 AADT, the standards are not exceeded by a large amount. Many larger, 4th order or higher, streams that don't drain urban areas should have higher volumes of background water of low metals concentration available to dilute most road runoff discharges. Above 30,000 AADT, there is an increased chance of stormwater discharges with very high metals concentrations that need more dilution capacity.

Assumptions Behind the Above Guidance

1) Most 4th order streams that primarily drain watersheds outside of urban growth areas will have adequate quantities of water with low dissolved metals concentrations such that they can receive discharges that do not exceed the acute standards by more than 2x to 5x. The WSDOT April 2004 report on flow control exemptions provides a listing of streams that fall into different levels of Strahler "order." Most 4th order streams (on 1:24,000 maps) that drain rural areas would seem to have sufficient water and low enough background metals concentrations that they can absorb a rather large discharge without causing an exceedance of the water quality

criteria. The table in the April 2004 report only gives Mean Annual Flows. These flows are likely higher than what we would see in these creeks during a rain event in August through early October. Records of summer/early fall low flows in these creeks are probably closer to a flow upon which to estimate potential available dilution.

2) The proposal has different thresholds for areas within and outside of urban growth areas. In the Puget Sound area, along the Columbia River and on the Pacific Coast, urban growth areas are generally at the downstream end of drainages. The urban growth area extends from an eastern border, through multiple jurisdictions, to Puget Sound, the Columbia, or the coast. The proposal does not work as well (not as protective) for roads that are downstream of urban growth areas. It assumes that a stream does not have elevated metals concentrations. But if a stream has a significant portion of its basin serving an urbanized area that is upstream of the project, it might not have much dilution capacity. Since urbanization usually occurs at the low end of basins, it is the layout that is most appropriate for making the generic, default requirements.

References:

Kayhanian, Masoud, Amardeep Singh, Claus Suverkropp, and Steve Borroum, "Impact of Annual Average Daily Traffic on Highway Runoff Pollutant Concentrations", Journal of Environmental Engineering, November 2003.

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WSDOT Annual Reports for Compliance with its Municipal Stormwater Permits

"Highway Stormwater Runoff Study," Michigan Department of Transportation, April 1998

For more information

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